Paper No. 39

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte YUKIHISA TAKEUCHI and KOJI KIMURA

Appeal No. 1998-0865
Application No. 08/488,455

HEARD: November 28, 2001

Before FLEMING, GROSS, and BARRY, Administrative Patent Judges.

GROSS, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection of claims 2 through 6 and 8 through 12, which are all of the claims pending in this application.

Appellants' invention relates to a piezoelectric device with a piezoelectric transducer on a ceramic substrate. The substrate has a thin-walled portion defining a recess within the substrate and being curved into the recess. The

piezoelectric transducer is formed on the concave side of the thin-walled region of the substrate and is curved in the same direction as the substrate. Claim 2 is illustrative of the claimed invention, and it reads as follows:

2. A piezoelectric device comprising:

a ceramic substrate with at least one thin-walled region defining at least one recess within said substrate, said thin-walled region being curved into said recess; and

at least one piezoelectric transducer formed on the concave side of said thin-walled region of the substrate, said piezoelectric transducer being in the form of a film and including a piezoelectric layer arranged between two electrode layers, said piezoelectric transducer being curved in the same direction as said thin-walled region.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Hubbard	4,635,079	Jan. 06, 1987
Takeuchi et al. (Takeuchi I)	5,210,455	May 11, 1993
Takeuchi et al. (Takeuchi II)	EP 0,468,798	Jan. 29, 1992

Claims 2 through 6 and 8 through 12 stand rejected under 35 U.S.C. § 103 as being unpatentable over Takeuchi I or II in view of Hubbard.

Reference is made to the Examiner's Answer (Paper No. 28, mailed October 24, 1997) for the examiner's complete reasoning in support of the rejections, and to appellants' Brief (Paper No. 27, filed September 18, 1997) and Reply Brief (Paper No. 30, filed December 15, 1997) for appellants' arguments thereagainst.

OPINION

We have carefully considered the claims, the applied prior art references, and the respective positions articulated by appellants and the examiner. As a consequence of our review, we will reverse the obviousness rejection of claims 2 through 6 and 8 through 12.

Independent claim 2 includes a substrate with a "thin-walled region being curved into said recess" and a piezoelectric transducer "being curved in the same direction as said thin-walled region." Thus, all of the claims require that both a portion of the substrate and also the transducer be curved into the recess.

The examiner admits (Answer, page 3) that the piezoelectric device of Takeuchi I or II "is not curved." The examiner turns to Hubbard to remedy this deficiency and asserts (Answer, page 3) that "Hubbard teaches a similar device usnig [sic] a curved piezoelement as it gives a preferred or biased direction of operation. . . . Thus, for at least the reasons taught by Hubbard, it would have been obvious to impart curvature to the drive sections of" Takeuchi I or II.

Hubbard teaches (column 1, lines 65-68) using a domed-shaped configuration for a ceramic piezo-electric element for "a transducer that does not require a diaphragm, as well as a transducer that provides a chamber of lesser space." The structure disclosed by Hubbard thus provides two advantages: the diaphragm may be eliminated, thereby reducing the number of elements, and the transducer may occupy less space along the substrate, thereby allowing for high density integration. Accordingly, it would have been obvious to the skilled artisan to use a dome-shaped transducer in the device of Takeuchi I or II and eliminate the diaphragm (i.e., the ceramic substrate) for both stated advantages. Alternatively, if removing the diaphragm were not desired, it would have been obvious to the skilled artisan that even with the ceramic substrate, one could still obtain the benefit of reduced space by using the dome shaped transducer.

Combining the teachings of Hubbard with Takeuchi I or II would yield a flat substrate with a dome-shaped transducer attached thereto. Appellants even admit (Brief, page 13) that "the combination . . . might suggest using convex-shaped inkwells . . . so that the inkwells could be formed closer

together thus increasing the dpsi printing capability of the ink jet print head." However, appellants argue (Brief, page 14) that:

> [O]ne skilled in the art would not attempt to use concave inkwells, since such inkwells would effectively have to be spaced farther apart in order to provide the minimum volume necessary within each inkwell. That is, . . . one would consequently reduce the volume of the inkwell, and thus reduce the amount of ink that can be carried in each inkwell. This result is diametrically opposite to the objective sought and result achieved by the dome-shaped piezoelectric layers used in Hubbard.

The examiner (Answer, page 4) points to column 3, lines 3-8, of Hubbard as teaching that both concave and convex curvatures are "predicted to achieve operable transducers." However, lines 7-8 state that "the disadvantage of this resides in the reduction of the volume of the cavity **32**." In other words, the referenced portion of Hubbard must be taken to mean that the ability to eliminate the diaphragm exists regardless of the direction of curvature of the transducer, but with a concave curvature either the cavity volume will be reduced (thus reducing the amount of ink carried in the ink well) or the space occupied will increase (thereby decreasing the

density, which opposes the reason for combining). Thus, we find that it would not have been obvious to combine the teachings of Hubbard and Takeuchi I or II to form a transducer with a concave curvature.

Nonetheless, assuming *arguendo* that one were to consider Hubbard as suggesting a ceramic substrate and a transducer curved into a recess in the substrate, the combination still fails to meet each and every element of the claims. Specifically, as indicated above, claim 2 requires not only that the transducer be curved, but also that a portion of the substrate be curved. Nowhere in any of the cited references do we find a teaching or suggestion to curve a portion of the substrate. Instead, Hubbard suggests forming a recess in the substrate on the side carrying the transducer and bending the transducer into the recess. Accordingly, the examiner has failed to establish a *prima facie* case of obviousness. Therefore, we cannot sustain the rejection of claims 2 through 6 and 8 through 12.

CONCLUSION

The decision of the examiner rejecting claims 2 through 6 and 8 through 12 under 35 U.S.C. § 103 is reversed.

REVERSED

MICHAEL R. FLEMING Administrative Patent Judge	)	
ANITA PELLMAN GROSS Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
LANCE LEONARD BARRY Administrative Patent Judge	)	

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